Sept. 3, 1963 J. S. NEAL 3,102,362

MAGNETIC BALL WITH PARTICULAR MOUNTING FOR THE MAGNET THEREOF

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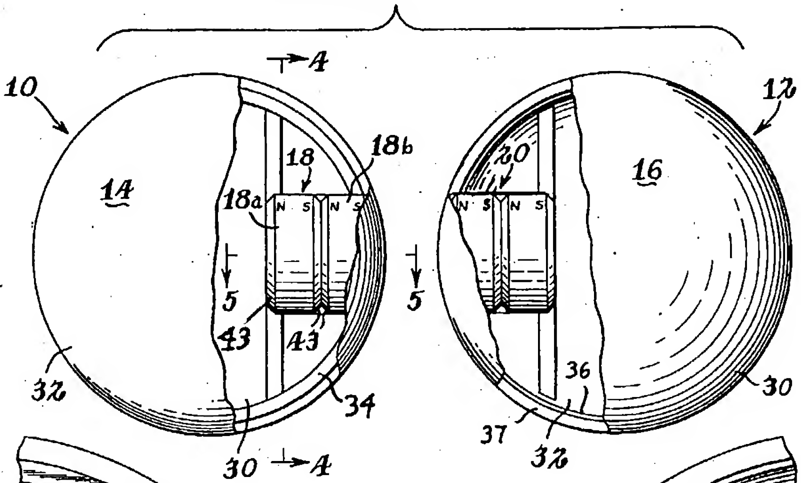
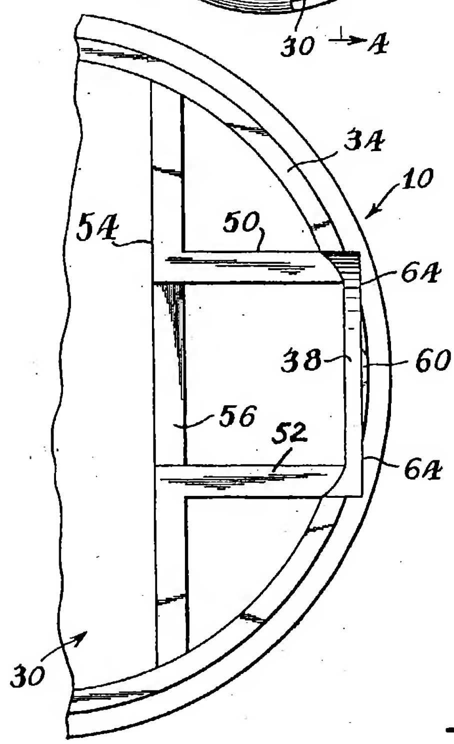
Fig. 1.





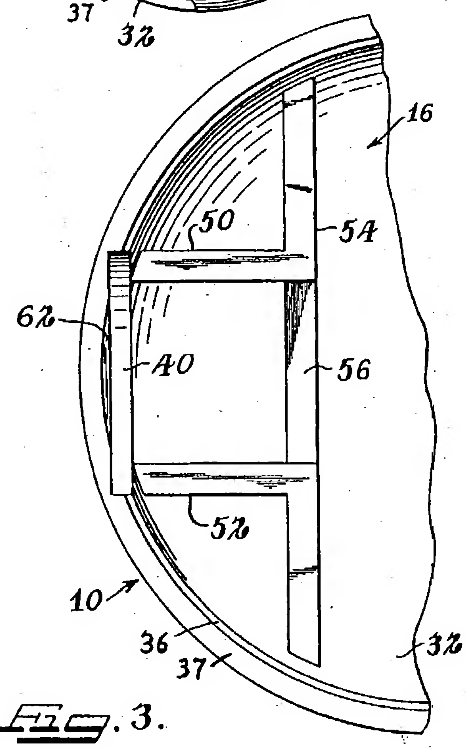


Fig. 3.

Fig. 2.

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Fig. 4.

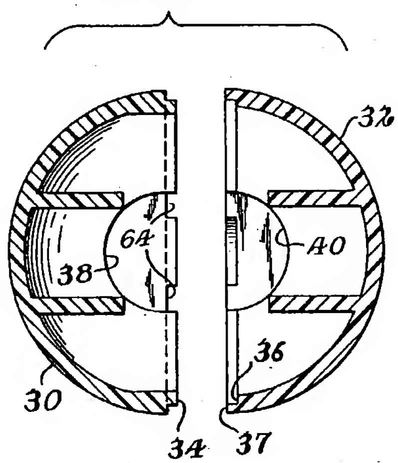
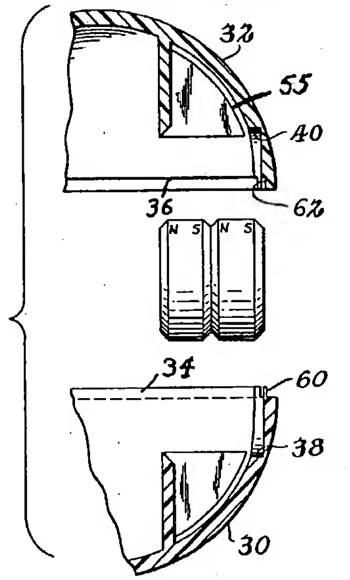


Fig. 5.



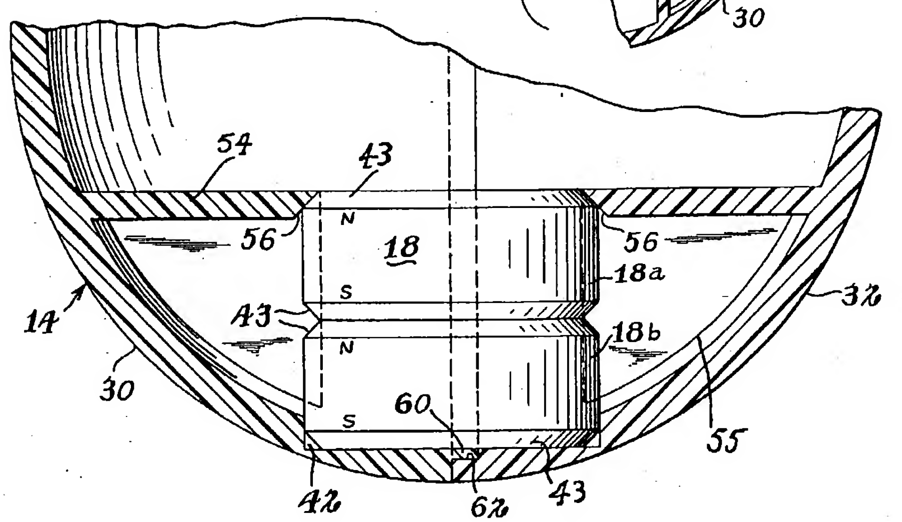


Fig. 6.

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MAGNETIC BALL WITH PARTICULAR MOUNTING FOR THE MAGNET THEREOF

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3 Claims. (Cl. 46—236)

The present invention relates generally to amusement devices and has particular reference to a toy having magnetic characteristics. The invention is specifically concerned with a toy ball comprised of a permanent magnet and a carrier which, by reason of the permanent magnet carried thereby, is able to perform unusual functional acts.

According to the present invention, it is contemplated that the ball shall be in the form of a lightweight, closed, spherical shell, in other words a hollow ball, and that the permanent magnet shall be in the form of a small but relatively heavy permanent magnet, the magnet being fixedly mounted within the shell at an eccentric location, preferably close to and coterminous with the spherical wall of the shell, i.e., near the surface of the shell, so that the magnet, considered as an object and independent of its mangetic properties, will cause the ball, when given an impetus and set into motion, to roll in an irregular and amusing manner with a gyrating or otherwise uneven motion and with irregular velocity having alternating increments of acceleration and deceleration. When rolled on a non-magnetic surface, the ball will roll in such irregular manner until its kinetic energy has been dissipated at which time it will come to rest with a gradually diminishing oscillatory or rocking motion. When rolled on a magnetic surface, the permanent magnet will, due to its weight, immediately seek the magnetic surface and, as long as the momentum of the ball is sufficiently great as to overcome the magnetic attraction between the magnet and the magnetic surface, the ball will continue to roll in an irregular manner. When most of the kinetic energy of the ball has been dissipated, the force of the magnetic attraction exerted by the magnet on the surface will abruptly halt the motion of the ball and the latter will come to rest abruptly and with the permanent magnet assuming a position wherein it is at the nadir of the ball and is attracted to the magnetic surface so that the ball will become fixedly anchored to the magnetic surface at the point where the motion of the ball ceases. The magnet-containing ball of the present invention thus readily adapts itself as an individual game piece.

It is among the general objects of the present invention to provide a magnetic ball possessing great versatility and innumerable amusement possibilities as briefly outlined above.

Specifically, it is an object of the invention to provide a novel means for fixedly securing a permanent magnet within a hollow spherical shell with the magnet being securely clamped within the shell and held against rattling, both at the time of manufacture and after a period of use, and also being prevented from shifting its position with respect to the shell.

Until the advent of the present invention, efforts effectively to secure a magnet within a shell to produce a magnetic ball of the character briefly outlined above proved to be not altogether satisfactory. Where the magnet was bonded to the inside face of the shell, the bonding material would, in time, give way and the magnet would break loose within the closed shell. It is a common expedient to manufacture hollow spherical objects in two semi-spherical shell-halves and, thereafter, unite the halves at the circular rims thereof. This is particularly the case where the shell is formed of a plastic material by an injection molding process. Following such a procedure, attempts were made to secure the magnet within the shell by providing counterpart ribs or webs interiorly of the shell-halves, the webs moving into clamping straddling relationship with the magnet at the time the shell-halves were assembled. Such a procedure involves manufacturing difficulties in that the assembly operators are unable accurately to align the two shell-halves for proper registry of the webs with the magnet, this being, of course, because at the time of final closure of the semi-spherical shell-halves upon each other, the webs are substantially concealed from view. The use of webs, however, is ideal in that the webs, in addition to their magnet-clamping function, also reinforce the shell and, in a toy ball where the magnet-containing shell is frequently thrown with a considerable degree of force against a solid surface, diametric or chordal reinforcement is essential.

The present invention affords a solution to the problem of orientation of the shell-halves in assembly procedure and, accordingly, it contemplates the provision of a novel mounting for the magnet within the shell, the mounting comprising opposed complemental magnet-retaining or magnet-clamping webs which are formed in the respective shell-halves and require for their proper mutual clamping action accurate alignment in the completed shell, together with a cooperating tongue and recess on the two shell-halves, respectively, the tongue being circumferentially slidable on the rim region of the counterpart shell-half at the time of assembly and when the two circular rims of the shell-halves are brought into juxtaposition, until such time as the tongue snaps into position within the recess, at which time the two shell-halves are in proper circumferential register so that the cooperating webs of the two shell-halves are in alignment for reception of the magnet therebetween. The provision of such a tongue and recess constitutes a feature of the present invention insofar as shell structure is concerned. This feature possesses further significance in that the tongue and coacting recess are formed directly on the rim regions of both shell-halves and in such manner that there is no increase in thickness of the rim region or edge of either shell-half with the result that the thin wall of the shell is preserved throughout in the complete ball, thus maintaining shell lightness which is necessary in order to give full significance to magnet weight and not detract from the ball's ability to attain the unusual irregular rolling effects previously mentioned. Because of the fact that the tongue and recess connection is one where the tongue slides into place and locks in the recess upon relative circumferential turning movement between the two shell-halves, in the assembly process the operator may preliminarily assemble the two shell-halves in any desired rim relationship and, thereafter, without focusing any attention on the assembly, rotate the two shell-halves relatively to each other until an audible click is heard or, alternatively, until the click impact is felt manually. Assembly of the two sell-halves thus lends itself readily to unskilled labor or blind talent.

Another and ancillary advantage of the present magnet-securing means resides in the provision of a half-socket in the semi-spherical wall of each shell-half, the two shell-halves, when brought together in the assembly process, serving to complete the socket and the socket constituting not only a seat for one end of the magnet, but also serving to bring a pole face of the magnet closer to the outside surface of the spherical shell so that the attractive force of the magnet on outside magnetic objects will be increased.

Finally, the tongue of the aforementioned tongue and recess connection is formed on the bottom wall of the half-socket of one shell-half, while the recess is formed in the bottom wall of the half-socket of the other shell-half, this arrangement making it possible to construct

the tongue in the form of a very thin and flexible finger-like element which can flex without breaking to an off-side position when the two rims of the shell-halves are brought together in any circumferential relationship other than a proper position of tongue and recess alignment, and which will slide in its flexed condition during relative rotation between the two shell-halves until it snaps into the recess at the time the two shell-halves are properly mated.

The provision of a magnetic or magnet-containing ball having novel magnet-mounting or retaining means for the magnet being among the principal objects of the invention, numerous other objects and advantages of the invention will become readily apparent as the following description ensues.

In the accompanying two sheets of drawings forming a part of this specification, a preferred embodiment of the invention has been shown.

In these drawings:

FIG. 1 is a side elevational view of two magnet-containing balls each constructed in accordance with the principles of the present invention, and showing a portion of each shell broken away in order more clearly to reveal the nature of the invention, the magnets of the two shells being differently positioned in the shells so that the shells are capable of mutual attraction;

FIG. 2 is a fragmentary plan view of the open side of one of the two shell-halves which, when assembled upon each other, produce one of the two magnet-containing balls of FIG. 1, the magnet being removed in the interest of clarity;

FIG. 3 is a fragmentary plan view of the open side of the other of the two shell-halves;

FIG. 4 is an exploded sectional view taken on the line 4—4 of FIG. 1;

FIG. 5 is an exploded sectional view taken on the line 5—5 of FIG. 1; and

FIG. 6 is an enlarged unexploded sectional view taken on the same line of FIG. 1 as FIG. 5.

Referring now to the drawings in detail and in particular to FIG. 1, briefly, there are two counterpart spherical objects or balls each including two principal parts, namely, a closed hollow spherical shell and a permanent magnet. In the interests of clarity and consistency throughout this specification and in the claims appended thereto, each spherical object, inclusive of the shell and its contained magnet, will be referred to as a ball, while the shell alone will be referred to as a shell. The two counterpart balls have been designated in their entirety by the reference numerals **10** and **12**, their shells by the reference numerals **14** and **16**, and their magnets by the reference numerals **18** and **20**.

The magnet of each ball is cylindrical and it is wholly contained within its associated spherical shell and is fixedly mounted therein with its axis extending radially of the shell and with one end face lying near the outer surface of the shell. The physical length as well as the magnetic length of the magnet is relatively small as compared to the radius of the sphere so that the entire body of the magnet lies near the periphery of the shell. The shell of each ball is formed of comparatively lightweight material, preferably a moldable plastic material of the phenol-formaldehyde condensation product type which is readily acceptable to injection molding processes, although it may be formed of other lightweight material, such as Celluloid, aluminum or an aluminum alloy, the material being essentially non-magnetic. Each magnet, in comparison with its associated shell, is relatively heavy and, since it lies near the surface of the shell as previously mentioned, the center of gravity of the shell as a whole is considerably removed from the geometrical center of the shell so that the ball will not roll evenly on a plane surface but will, when an attempt is made to roll it, perform a series of gyrations which terminate in a rocking motion during which the ball seeks to attain a degree of stable equilibrium with the magnet by reason of its offset position and relatively great weight, assuming a vertical position of close proximity to the supporting surface and at the nadir of the shell.

The two balls **10** and **12** are identical insofar as their size and physical construction are concerned, as are the two magnets. Magnetically, however, the balls differ in that the magnet of one ball is reversely oriented or, in other words, turned end-for-end in its shell. The circular end faces of the cylindrical magnets constitute the pole faces thereof and thus one magnet presents a pole of one polarity to the periphery of its respective shell, while the other magnet presents a pole of opposite polarity to the periphery of its respective shell. Since the magnetic poles attract each other, the two balls are capable of being drawn toward each other by magnetic attraction when the balls are brought into close proximity with each other with the magnetic fields of the two magnets overlapping, so that they are linked magnetically. Under such conditions, the final position of the balls will be a mutually tangential one with the two magnets opposing each other in axial alignment or nearly so.

From the above description it will be appreciated that, when either ball is rolled individually on a magnetic surface, the gyrating motion of the ball will be more abrupt than when the ball is rolled on a non-magnetic surface and the magnet will repeatedly have its flux path linked with the magnetic surface until such time as the forward momentum or kinetic energy of the ball has been dissipated to such an extent that the attraction between the magnet and the magnetic surface is predominant, at which time the ball will quickly come to rest in a nadir position with the magnet having its axis extending vertically and with the outermost pole face in close proximity to the supporting surface. Thus, the balls **10** and **12** readily lend themselves to the type of game where a magnetic board is provided and the object of the game is to roll the balls on the magnetic board with a view toward causing the same to come to rest within a given marked area of the board.

The magnets **18** and **20** are preferably ceramic magnets of the mixed ferrite type, such magnets being a comparatively recent development in the field of magnet construction and possessing greatly improved magnetic properties over permanent magnets which are constructed of metallic alloys.

One such magnetic material capable of being employed in connection with the present invention for construction of the magnets **18** and **20** is the material known as "Indox," a development of the Indiana Steel Products Company, of Valparaiso, Indiana. This barium-ferrite material is characterized by the fact that it is electrically non-conductive. The material is extremely resistant to demagnetizing influences and evidences very low eddy current losses. "Indox" is a magnetic material which exhibits extremely high coercive forces, a low remanence and high permeability. Because of these characteristics of this permanent magnet material, the magnetic length thereof need be but a fraction of that required for the ferrous alloys in attaining the same magnetic pull for a given magnet size. Where barium-ferrite ceramic materials are concerned, magnetic stability is pronounced and permanent magnets of this character maintain their magnetic strength despite weakening influences, such as contact with extraneous fields and frequent removal and replacement of magnetic armatures. The fact that magnets of the barium-ferrite type may be made with a relatively short magnetic length without sacrificing attractive power is extremely relevant to the present invention in that the entire body of the magnet, in the case of each ball **10** and **12**, may be kept near the periphery of the ball for off-center weighting purposes.

According to the present invention, novel means are provided for fixedly securing the magnets **18** and **20** in their respective shells **14** and **16**. Inasmuch as both shells

are identical, as are both magnets from a physical point of view, a description of one shell and its respective magnet, together with the securing means for the magnet, will suffice for the other.

Each shell, for example the shell 14, is of a two-part sectional nature and is comprised of nearly or substantially identical semi-spherical shell-halves 30 and 32. As best seen in FIGS. 2, 3 and 4, the open circular rim of the shell-half 30 is formed with a forwardly extending short, thin annular inside rim flange 34 which interlocks with a mating annular inside groove 36 on the rim of the shell-half 32. When the two shell-halves are assembled upon each other in rim-to-rim relationship, the flange 34 and the groove 36 interfit.

The magnet 18 is disposed adjacent to the shell wall, i.e., near the periphery of the shell. It is seated in an internal shallow circular socket which is represented by two socket-halves 38 and 40, the socket-half 38 being provided at the rim of the shell 30, and the socket-half 40 being provided at the rim of the shell 32. When the rims of the two shells are brought together in the assembly process, the two socket-halves produce the complete socket 42 (see FIG. 6).

While the magnet 18 may be of unitary or one-piece construction, for purposes of use in the present assembly, it preferably is constructed in two identical magnet sections 18*a* and 18*b*, both being cylindrical wtih bevelled rim surfaces 43. Whether the magnet 18 be of unitary construction or of composite construction as shown, when considered as a whole, its magnetic properties are not affected. It is well known that when an elongated bar magnet is severed intermediate its ends, the severed sections become individual magnets which, when axially aligned with their original orientation preserved, present end faces which become pole faces and which have the same polarity as the pole faces of the bar magnet before severing. When the parts are reunited in their original relationship, the original bar magnet is, in effect, restored with full magnet strength. What is true of a bar magnet of the ferrous alloy type is equally true of a ceramic or barium ferrite magnet. The polarity of the end faces of the magnet sections 18*a* and 18*b* has been indicated in FIG. 6 by the letters N and S, the polarities of the extreme end faces representing the polarities of the end faces of the entire magnet 18 considered as a whole. It is to be noted that an end face having an S polarity seats within the socket 42.

The composite magnet 18 is fixedly secured within the assembled shell 14 partly by reason of its being seated within the socket 42 and partly by reason of its being straddled and clamped by the edge regions of a series of three webs which are formed internally on each of the shell-halves 30 and 32. The webs of each shell-half are identical and, therefore, a description of one series of webs will suffice for them both.

As best seen in FIGS. 2 and 3, each series of webs when viewed edgewise forms a structure resembling the Greek letter π. The series includes two parallel webs 50 and 52 which, in the position in which the shell-half 30 assumes in FIG. 2, extend horizontally. The webs 50 and 52 are bridged by a third web 54 which overhangs the edges of the webs 50 and 52. All of the webs are integrally molded with the associated shell-half and the base edges of the webs all merge with the inside shell surface along curved lines as indicated at 55 in FIGS. 5 and 6. The forward edges of the three webs are linearly straight and they terminate in a common plane which is parallel to the plane of the shell-half rim but spaced a short distance from the last-mentioned plane. When the two shell-halves 30 and 32 are assembled upon each other in rim-to-rim relationship, corresponding webs of the two series are coplanar and the opposed edges of the webs serve to clamp the magnet 18 therebetween. The magnet is thus engaged linearly by the webs 50 and 52 along four straight, longitudinally extending lines, and its inner rim region is

engaged by the two edges of the opposed edges of the webs 54. In order more effectively to enhance the clamping action exerted by the webs 54, the edges of these webs which engage the magnet are bevelled as at 56 conformably to certain of the bevelled rim surfaces of the magnet 18 as best seen in FIG. 6. The direction of the bevelled surfaces 43 and 56 is such that the magnet 18 is forced radially outwardly in the shell 14 and caused to seat firmly in the socket 42.

In the assembly process whereby the two shell-halves 30 and 32 are manually moved to their rim-to-rim relationship, it is extremely difficult for an operator properly to align any internal clamping webs which may be provided within the two shell-halves for magnet-clamping purposes. According to the present invention, this problem of alignment of the shell-halves is eliminated by the provision of a novel tongue and recess arrangement which is provided on the two shell-half rims in the vicinity of the socket 42. This tongue and recess arrangement is comprised of a tongue 60 and a recess 62, the tongue being of thin half-moon in transverse cross section as shown in FIG. 2, and the recess being of conformable or complementary configuration.

Disregarding the fact that the shell-halves 30 and 32 are molded articles, the tongue 60 may best be described by considering it as a remnant of the annular inside flange 34 which remains immediately below the bottom wall of the socket-half 38 by reason of the fact that the socket-half is deeper than the wall thickness of the flange. This relationship may be seen in FIG. 2. The bottom wall of the socket is flat and it cuts through the flange 38 at spaced regions 64 (see FIGS. 2 and 4) but the half-moon portion which constitutes the tongue 60 remains.

The recess 62 in the shell-half 32 is formed in an annular outside flange 37 which surrounds the groove 36 and it may also be regarded as being formed in the bottom wall of the socket-half 40 as shown in FIGS. 3 and 4. When the two shell-halves 30 and 32 are assembled in their rim-to-rim relationship, the tongue 60 completely fills the recess 62 and thus the continuity of the bottom wall of the socket 42 is preserved.

The tongue and recess arrangement described above insures accurate circumferential register of the two shell-halves which, in a contemplated commercial embodiment of the invention, may be decorated with two design-halves adapted for complementary mating or register when the shell-halves are assembled. No design has been illustrated herein but it will be understood that for a complete design it is essential that any two design-halves shall accurately register and thus the tongue and groove arrangement 60, 62 insures proper registry of the shell-halves despite large manufacturing tolerances which are known to exist in the manufacture of ceramic magnets, an undersize magnet allowing for limited circumferential misalignment of the shell-halves at the time of assembly.

The invention is not to be limited to the exact arrangement of parts shown in the accompanying drawings or described in this specification as various changes in the details of construction may be resorted to without departing from the spirit of the invention. Therefore, only insofar as the invention has particularly been pointed out in the accompanying claims is the same to be limited.

Having thus described the invention what I claim as new and desire to secure by Letters Patent is:

1. In a magnetic amusement device of the character described, a hollow spherical magnet-containing ball, said ball being comprised of first and second semi-spherical shell-halves formed of lightweight non-magnetic material, presenting open circular rims in coextensive abutting relationship, and producing together a hollow closed spherical shell, an inside annular rim flange on said first shell-half, an outside annular rim flange on said second shell-half, the two rim flanges overlapping each other and the combined thickness of the two rim flanges being equal to the

radial thickness of each shell-half, the rim regions of each shell-half being formed with an internal shallow semi-circular socket-half, the two socket-halves being in circumferential register and, in combination, producing an internal shallow circular socket at the region of juncture between the two shell-halves, said socket being provided with a continuous flat bottom which extends across the juncture region between the two shell-halves, the depth of said socket being slightly in excess of the thickness of the inside rim flange of the first shell-half so that the socket extends into the outside rim flange of the second shell-half and relieves a limited inside portion thereof while at the same time relieving spaced regions of the inside rim flange of the first shell-half with the intervening portion of said inside rim flange between said spaced relieved regions constituting a thin locking tongue and having a cross-sectional configuration in the form of a half-moon, a portion of the outside annular rim flange being relieved on the inner side thereof to provide a shallow recess conformable in configuration to the configuration of said locking tongue and within which recess the locking tongue is received and substantially completely filled thereby, a generally cylindrical permanent magnet of the barium ferrite type, having cylindrical pole faces at the opposite ends thereof and of opposite polarity, disposed within said shell and having one end face thereof seated within said socket so that the axis of the magnet extends radially of the shell, each shell-half being formed with a pair of spaced parallel flat internal webs having edges which engage and extend longitudinally along the outside cylindrical surface of the magnet substantially coextensively with the length thereof, the webs of the two shell-halves serving to straddle the magnet and confine the same therebetween, each shell-half being formed with a third internal web extending at a right angle to and bridging the distance between the two webs of the associated shell-half, the third webs of the two shell-halves making tangential contact with the end region of the magnet remote from the seated end face of the magnet, the axial extent of said magnet being less than the radius of the shell.

2. In a magnetic amusement device, a hollow spherical magnet-containing ball as set forth in claim 1 and wherein the end region of the magnet remote from the seated end is bevelled to provide a frusto-conical surface, and wherein the third web of each shell-half is formed with a bevelled edge making substantially tangential contact with said bevelled surface on the magnet.

3. In a magnetic amusement device, a hollow spherical magnet-containing ball, said ball being comprised of two substantially identical semi-spherical thin wall shell-halves formed of lightweight non-magnetic material and having their forward circular rims disposed in coextensive edge-to-edge abutting relationship, each shell-half being formed with a pair of spaced internal webs disposed in respective chordal planes and having straight forward edges terminating in a common plane which extends at a right angle to said parallel chordal planes and parallel to the plane of the rim of the shell-half, and a third internal web also disposed in a chordal plane, said third web being joined to said pair of webs and bridging the distance therebetween, said third web having a straight forward edge terminating in said common chordal plane, all of said three webs being disposed wholly within the confines of the shell-half and on one side of a diametric plane perpendicular to the plane of said rim, the circumferential disposition of said shell-halves being such that the respective webs of the two shell-halves lie in common planes, the three webs of each shell-half defining, in combination with the semi-spherical wall of the shell-half, an internal half-socket, and a substantially cylindrical permanent magnet of the barium ferrite type disposed within said shell, with its longitudinal axis extending at a right angle to the common plane of the two webs, said magnet making line contact with the forward edges of the spaced internal webs of each shell-half, having one end face thereof seated on a portion of the wall of each shell-half, and having the rim region thereof which is remote from said end face in tangential contact with the forward edges of said third webs, a portion of said magnet projecting into each half-socket.

References Cited in the file of this patent

UNITED STATES PATENTS

2,277,057	Bach	Mar. 24, 1942
2,524,546	Sinclaire	Oct. 3, 1950
2,838,009	Bonanno	June 10, 1958